

Monetary Economics

Money and Inflation and the Optimum Quantity of Money

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Outline

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- 2 Changes in the Price Level and Inflation
- 3 Change in Supply of Money
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- 5 Optimum Quantity of Money
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Demand for Money

- Version of demand for money by households and firms with zero interest rate on money

$$\left(\frac{M}{P}\right)^d = \left(\frac{M}{P}\right)^d (y, R)$$

- M is the nominal quantity of money
- P is the price level (dollars e.g. per unit of the commodity)
- y is real income – increases lead to increases in the real quantity of money demanded
- R is the interest rate on the alternative asset – increases lead to decreases in the real quantity of money demanded
 - ▶ Opportunity cost of holding money
 - ▶ There might be many alternative assets whose interest rates affect the demand for money
- $\left(\frac{M}{P}\right)^d$ is both the real quantity of money demanded and indicates the function on the right

Demand for Money with Interest on Money

- Version of demand for money by households and firms with a nonzero interest rate on money

$$\left(\frac{M}{P}\right)^d = \left(\frac{M}{P}\right)^d(y, R - R_m)$$

- ▶ R_m is the interest rate on money
- ▶ Generally get difference in interest rate is the important variable from the budget constraint
- ▶ Again $R - R_m$ is the opportunity cost of holding money

Supply of Money

- Supply of money is a supply of a nominal quantity of money

$$M^s = M_0$$

- ▶ M^s is the nominal quantity of money supplied
- ▶ A constant supply certainly is not the only possibility but it is convenient for the moment

Equilibrium of Money Demand and Supply

- Have real quantity of money demanded and nominal quantity supplied
- Equilibrium

$$\left(\frac{M}{P}\right)^d = \frac{M^s}{P}$$

Equilibrium

- Have four variables M, y, R, P with zero interest rate on money
- M is determined by supply of money
- Now have three variables left and one equation

$$\left(\frac{M}{P}\right)^d = \frac{M_0}{P} = \left(\frac{M}{P}\right)^d(y, R)$$

- Friedman supposes that real income is “ground out by the Walrasian system of equations”
 - ▶ Determined independently of changes in the quantity of money, at least in the long run
- Nominal interest rate is

$$R = r + \pi^e$$

- ▶ where r is the expected real interest rate
 - ▶ and π^e is the expected inflation rate
 - ▶ Why expected?
- Friedman also supposes that the expected real interest rate is determined by real factors

Equilibrium With Some Variables Determined

- Equilibrium condition

$$\left(\frac{M}{P}\right)^d = \frac{M_0}{P} = \left(\frac{M}{P}\right)^d(y, r + \pi^e)$$

- ▶ Now have y , r , and M determined
- ▶ Left with P and π^e and one equation

$$\pi^e = \left(\frac{1}{P} \frac{dP}{dt}\right)^e$$

- Price level determined if expected inflation rate determined
- Inflation rate determined if expected inflation equals actual inflation

Inflation

- “Inflation is always and everywhere a monetary phenomenon.”
Friedman
 - ▶ An empirical statement
 - ▶ I would say this is consistent with the evidence
 - ▶ We will look at some of that evidence

Process Leading to Changes in Price Level and Inflation

- Friedman: Encyclopaedia Britannica without parenthetical explanation

[T]hree of the most basic principles of monetary theory: (1) the central distinction between the nominal and the real quantity of money ...; (2) the equally crucial contrast between the alternatives open to the individual and to the community as a whole ...; and (3) the importance of attempts [to spend more than is being received in income]

Basic Principles

- First principle

(1) the central distinction between the nominal and the real quantity of money

(because to each individual separately—in this hypothetical example and in the real world—it looks as if income is outside any individual's personal control, but each individual can determine how much cash to hold)

Basic Principles

- Second principle

(2) the equally crucial contrast between the alternatives open to the individual and to the community as a whole

(because for the community as a whole, the total amount of cash is fixed, but the community is able to determine the size of its income in dollars);

for the individual, the total amount of cash held is variable but the size of an individual's income is fixed (independent of how much cash is held)

Basic Principles

- Third principle

(3) the importance of attempts [to spend more than is being received]

(that is to say, the collective attempt of people to spend more than they receive, even though doomed to frustration, because this ultimately raises total nominal expenditures and receipts)

Increase in Level of Money Supply

- Increase in the supply of money from M_0 to M_1
- Algebraically,

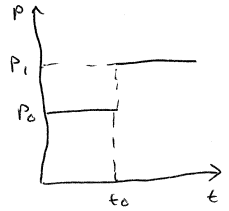
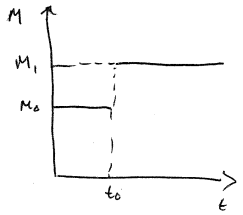
$$\left(\frac{M}{P}\right)^d = \frac{M_0}{P} = \left(\frac{M}{P}\right)^d (y, r + \pi^e)$$

- and

$$\left(\frac{M}{P}\right)^d = \frac{M_1}{P} = \left(\frac{M}{P}\right)^d (y, r + \pi^e)$$

- Assume that y and r are not affected
- If the expected inflation rate π^e is not affected, then P increases
- Graph of price level (hand drawn)

↑ M

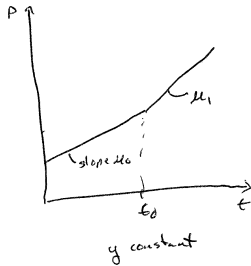
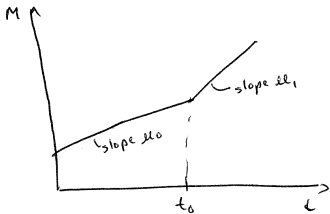


Increase in Growth Rate of Money Supply

- Money supply determined by $M(t) = M_0 e^{\mu t}$
 - ▶ Graph of nominal quantity of money
 - ▶ Growth rate of nominal quantity of money is μ
- Price level
 - ▶ If expected inflation rate π^e is not affected, then P increases
 - ▶ Suppose that real income and the expected real interest rate do not change
 - ▶ Inflation rate initially is zero
 - ▶ Graph of price level
 - ▶ Graph of nominal income $Y = Py$

(2)

↑ Growth rate of M



Increase in Growth Rate of Money Supply

- Money supply is determined by $M(t) = M_0 e^{\mu t}$
- Is it reasonable to suppose that the price level is continually increasing at the rate π and the expected inflation rate is unchanged?
 - ▶ Start at zero expected inflation rate if inflation rate was zero for a long time
- What would happen if expected inflation rate increased also?

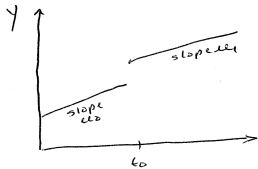
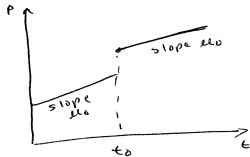
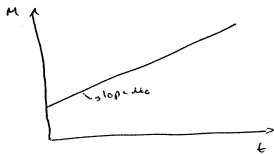
Increase in Expected Inflation Rate

- Nominal quantity of money constant
- What happens if the expected inflation rate π^e increases?
 - ▶ Increase in nominal interest rate and opportunity cost of holding money
- Decrease in demand for money
 - ▶ Same nominal quantity of money as before

$$\left(\frac{M}{P}\right)^d = \frac{M_0}{P} = \left(\frac{M}{P}\right)^d(y, r + \pi^e)$$

- ▶ Algebra says a higher price level
- ▶ Why?
- ▶ Graph of price level
- ▶ Graph of nominal income

Increase in expected inflation rate

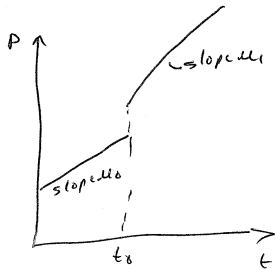
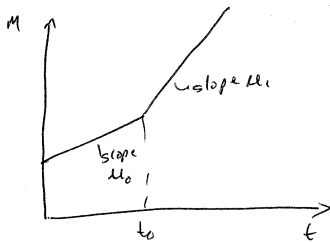


$$Y = P \cdot y$$

Increase in Growth Rate of Money Supply and Expected Inflation Rate

- Money supply determined by $M(t) = M_0 e^{\mu t}$
 - ▶ Growth rate of nominal quantity of money is μ
 - ▶ Inflation rate rises in equilibrium from zero to μ
 - ▶ Expected inflation rate rises in equilibrium to μ
- Price level
 - ▶ Inflation rate initially is zero
 - ▶ Suppose expected inflation rate increases to new higher rate when growth rate of money supply increases
 - ▶ Graph of price level

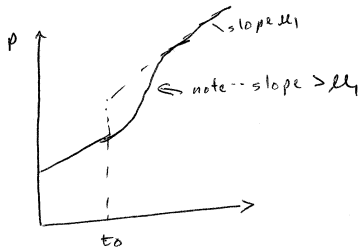
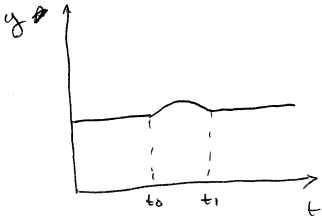
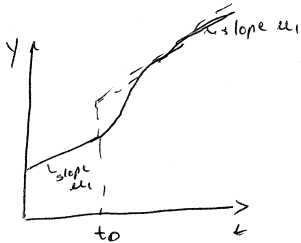
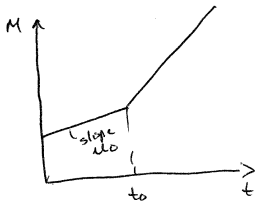
Increase in Growth rate of M &
Expected Inflation rate at same time



Adjustment over Time

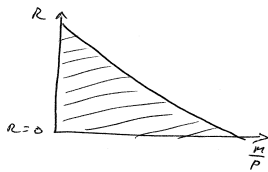
- Real income and interest rate might be affected
- Nominal income and spending
 - ▶ What if adjustment not instantaneous?
 - ▶ Graph of nominal income
 - ▶ Graph of real income
 - ▶ Graph of price level

Increase in Growth rate of M & Expected inflation rate at ~~some~~ some time over time



Consumer Surplus and Optimum Quantity of Money

- Consumer surplus plus zero opportunity cost of producing money suggests a nominal interest rate of zero
 - ▶ Graph
 - ▶ Partial equilibrium argument and not obviously entirely satisfactory in this context
- Friedman presents a detailed argument for simple economies based on equilibrium conditions



Equilibrium Conditions – Money and Capital

- Why is money held when it has a positive opportunity cost?
 - ▶ Provides services – marginal nonpecuniary services (measured in cents per dollar per year)
 - ▶ Possibly productive for firms – marginal product of real money balances in production
 - ★ Leave this aside

Real Return and Costs of Holding Money

- Real return and costs of holding a real money balance
- Increase in the purchasing power of a dollar $= -\frac{1}{P} \frac{dP}{dt}$
- Marginal nonpecuniary services – cents per dollar per year – $MNPS$ – a nominal return
- Cost of abstaining from a dollar of consumption with constant real consumption $IRD(0)$
- Equilibrium so far

$$-\frac{1}{P} \frac{dP}{dt} + MNPS = IRD(0)$$

- Suppose also hold an asset denominated in dollars that has the riskfree nominal interest rate $R = r + \frac{1}{P} \frac{dP}{dt}$
- Then

$$-\frac{1}{P} \frac{dP}{dt} + MNPS = r = IRD(0)$$

Optimum Quantity of Money

- Have

$$-\frac{1}{P} \frac{dP}{dt} + MNPS = r = IRD(0)$$

- This can be written

$$MNPS = r + \frac{1}{P} \frac{dP}{dt} = IRD(0) + \frac{1}{P} \frac{dP}{dt}$$

- Marginal nonpecuniary services of money are produced at zero resource cost to anyone
 - ▶ This suggests $MNPS = 0$ is optimal
- Is there a way to do this?
- Suppose that deflation is costless, i.e. $\frac{1}{P} \frac{dP}{dt} < 0$ has no transition or permanent costs
- Then

$$\begin{aligned} MNPS &= 0 \Rightarrow -\frac{1}{P} \frac{dP}{dt} = r \\ R &= 0 \end{aligned}$$

Summary

- Increases in the stock of money increase the price level because people perceive themselves to be able to buy more and they try to do so
 - ▶ Increases in the stock of money do not in themselves increase output and so people are bound to be frustrated in their attempt to buy more
 - ▶ The price level increases, after which people no longer want to buy more than is being produced

Summary

- Suppose that
 - ▶ The marginal cost of creating and distributing money is zero
 - ▶ The level of output is independent of the inflation rate
- Then the optimal level of the riskfree *nominal* interest rate is zero
 - ▶ The marginal cost of creating money and the marginal benefit of holding money both are equal to zero
- The actual and expected inflation rate equals the negative of the actual and expected real interest rate